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EFFECTS OF NUMERICAL SIMULATION MODELS ON THERMAL CHARACTERISTICS OF COMBUSTION GAS FLOW EJECTED FROM GAS OXYGEN/KEROSENE ROCKET ENGINE

Abstract

Combustion gas flow ejected from a liquid rocket engine can provide an environment of high enthalpy supersonic gas flow field, which is suitable to test the temperature protective ability of the material or a thermal structure. Accurate thermal characteristics of the flow field directly affect the evaluation of test results. For the gas oxygen/ kerosene rocket engine, the process of the fuel and the oxidizer mixture and combustion process in the chamber is complex. Also after the combustion gas is ejected from nozzle, it is mixed with the air and expansion waves and compression waves appear alternatively, which cause pressure and temperature of the flow changing with the distance. All these factors make it difficult to simulate the flow field, especially the thermal parameters accurately. In this paper, considering the spray droplet evaporation and broken, the Lagrange discrete phase model and single step and double steps general reaction models of kerosene are used to simulate the flow filed in combustion chamber and nozzle. They were compared with the results of one-dimensional steady isentropic flow to study the effect of gas-liquid two-phase flow and chemical reactions models on the combustion chamber and nozzle flow parameters. The flow field ejected from nozzle is then simulated using numerical methods. At the same time, a test is carried out to measure the thermal environment parameters, including static temperature, total pressure and temperature of the combustion gas ejected from the engine. The results of numerical simulation results are compared with the test data and the accuracy of various simulation methods were evaluated.